Heavy Metals in the Environment: An Overview

by Bruce A. Fowler,* Conference Chairman

Heavy metals such as lead, cadmium, and mercury are widely distributed throughout the environment as the result of soil erosion and industrial and agricultural processes. These elements constitute a very important group of environmental toxicants since they are potent metabolic poisons to plants, animals, and man.

The symposium on "Heavy Metals in the Environment" was sponsored by the National Institute of Environmental Health Sciences to bring together the many aspects of heavy metal research presently underway in the Research Triangle and to encourage communication and cooperation among scientists engaged in this area of investigation.

Papers dealing with analysis and monitoring, epidemiology, pathology-toxicology, biochemistry, physiology and effects on the agricultural eco-system were presented to the approximately 100 attending investigators.

The analysis and monitoring section included reports concerning organic and inorganic mercury determinations by gas-liquid chromatography, neutron activation analysis of metals, measurement of metal characteristic x-rays produced by proton bombardment, and present methods of monitoring metals as air pollutants. A sensitive new method for separating organic and inorganic mercury through the use of metal chelators and gas-liquid chromatography seemed to provide a reliable means for distinguishing the two forms of mercury in various media including biological samples. Bombardment of samples by protons to yield characteristic x-rays from heavy metals was discussed as a rapid means for determining their relative concentrations. These two new procedures coupled with other presently available techniques of analysis may eventually make detection of metals more rapid and considerably more uniform throughout this important area of research.

Epidemiologic studies of arterial lead levels in relation to cardiac deaths and the Environmental Protection Agency tissue bank program for correlating tissue levels of heavy metals with overall health added perspective to experimental toxicity studies. Further comparison between human tissue burdens of metals and effects produced by these elements in animals should greatly aid in defining their potential toxicity to man at environmental levels.

Reports concerning the toxic effects of heavy metals on experimental animals centered on their metabolism and storage in relation to observed neuro- and nephrotoxicity. Interactions between the metals and other factors like nutritional status, viral infections, noise, x-irradiation, other metals, and microsomal enzyme inducers were also thoroughly examined. The view that the toxicity of a given element must be considered in relation to other environmental stress factors was clearly apparent. Bio-

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chemical and physiological studies presented at the meeting dealt largely with the effects of metals on enzyme systems, membrane transport, and protein binding. Intracellular inactivation of proteins by heavy metals is one of the major mechanisms of toxicity.

The effects of heavy metals on plants and livestock were evaluated in relation to their extensive distribution in the agricultural environment. Studies concerning the influence of metals on soil microorganisms, uptake of nitrogen from the soil by plants and selection for certain plants in soils of high metal concentration were reported. Effects of metals on the physiology, reproduction, and viability of poultry were described along with a method for dealing with large amounts of metals administered as food additives to swine. The clear impact of heavy metals on organisms used as food by man rounded out the meeting.

In conclusion, this symposium demonstrated that a large and diverse group of investigators concerned with nearly every aspect of heavy metal research exists within the Research Triangle Park. The reports presented by this group clearly showed that heavy metals exert toxic effects on many biological organisms and that much unfinished work remains concerning the mechanisms and interactions of these effects. It is to be hoped that the Research Triangle may one day serve as a nucleus for expanding cooperation among scientists engaged in heavy metal research throughout this country and the world.